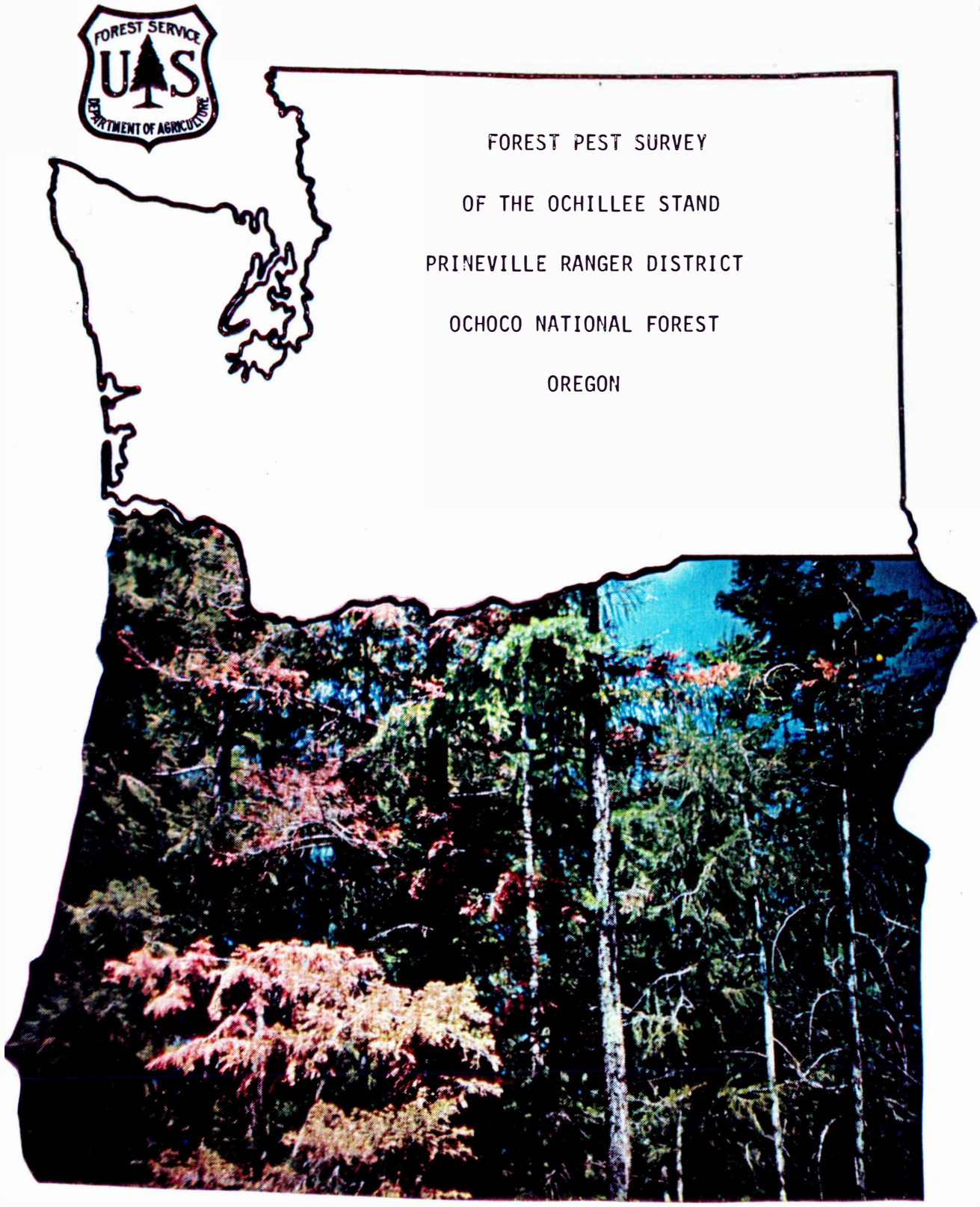
Forest Pest Management
Pacific Northwest Region



FOREST PEST SURVEY

OF THE OCHILLEE STAND

PRINEVILLE RANGER DISTRICT

OCHOCO NATIONAL FOREST

OREGON

FOREST PEST SURVEY OF THE OCHILLEE STAND, PRINEVILLE RANGER DISTRICT, OCHOCO NATIONAL FOREST, OREGON

by

Gregory M. Filip, Plant Pathologist
Forest Pest Management
Pacific Northwest Region
USDA Forest Service
Portland, OR 97208

Appreciation is extended to Scott Beyer and Ellen Beard from the Prineville RD for assistance in field work.

SUMMARY

A 40-acre stand on the Prineville Ranger District was examined for pest-caused losses. Nearly a third of the stand is affected by laminated root rot, resulting in a severe decrease in white fir and Douglas-fir yields due to growth loss and tree mortality. Other pests causing stand productivity losses include dwarf mistletoes in Douglas-fir and western larch, and heartrot and mortality caused by *Echinodontium tinctorium* and *Fomes annosus* in white fir. Management alternatives for these pests are discussed.

INTRODUCTION

The Ochillee Stand covers 40 acres, has a north aspect, and ranges from 4,800 to 5,100 feet in elevation (Figure 1). The slope is irregular, consisting of short steep sections (35% +) and gently sloping benches. A Douglas-fir/ponderosa pine overstory was partially removed in 1980 as part of the Windmill Timber Sale. Skid trail density and damage to the residual stand, primarily white fir, is high. Site index is 60 for white fir (index age 50 at DBH). The stand is a mixed-conifer-pinegrass plant community (CW-61-12).

The Prineville Ranger District requested that the stand be examined specifically for root diseases because of mortality evident in the white fir. An examination by Craig L. Schmitt and Donald J. Goheen, Plant Pathologists from Forest Pest Management, revealed the presence of annosus root and butt rot and severe damage due to *Phellinus weirii*, cause of laminated root rot. A more intensive survey to map infected areas was recommended.

This report discusses the results of that intensive survey conducted on October 11 and 12, 1983. A prescription on the Ochillee Stand is to be used to satisfy a requirement for certification by the District Silviculturist.

METHODS

The Ochillee Stand was surveyed with fixed-radius (1/100-acre) and variable (20 BAF) plots located at 2-chain intervals along transects 2 chains apart (Figure 2). Resource aerial photographs supplied by the District were used to locate the stand boundaries. Only trees greater than or equal to 5.0 inches DBH were tallied in variable plots. Trees less than 5.0 inches DBH but greater than or equal to 6 inches in height were included in fixed-radius plots. Data were collected for all trees on every fifth plot. On all other plots, data were recorded only for dead trees or living trees with disease signs or symptoms.

The following data were collected for each plot tree: (1) species, (2) DBH, (3) condition (healthy, live infected, recent kill, snag, stub, or dead down), and (4) cause of damage.

Root diseases were detected following partial excavation and dissection of roots and root collars. Only dead or highly symptomatic (thin crowns, spike-tops, basal resinosis) trees were examined. No attempt was made to detect root diseases in living trees without above-ground symptoms. Laminated root rot was identified by the presence of white ectotrophic mycelium on excavated roots and laminated decay with setal hyphae in stumps or root balls. Annosus root and butt rot was identified by the presence of stringy to laminated decay without setal hyphae. Armillaria root rot was detected by the presence of mycelial fans beneath the bark of the root collar or by yellow, stringy, decayed wood. Locations of root disease centers (3 or 4 trees in a group) were mapped in reference to plot locations.

The presence of witches'-brooms and/or branch swellings in the crowns indicated the presence of dwarf mistletoes. Severity of dwarf mistletoe infection in living trees was rated on a scale of 0 to 6 (Hawksworth 1977). Conks of *Echinodontium tinctorium* were identified based on their black, cracked upper surface and gray-toothed lower surface. Damage caused by bark beetles was identified by removing sections of bark and observing gallery patterns on dead or dying trees. Dead trees (standing or down) with intact bark on less than half of their circumference at the root collar were considered to have been dead for more than 20 years and were not measured since such trees often are too deteriorated to identify causal agents.

Results and Discussion

The Ochillee Stand was surveyed by a two-person crew in 2 days with a total of 77 plots. The most serious pest affecting productivity of the stand is laminated root rot caused by *Phellinus weirii* in white fir and Douglas-fir. Nearly a third of the 40-acre stand is visibly infected (Figure 2). This disease not only is affecting the current productivity of the stand, but future crops will become infected and produce reduced yields as a consequence. The following is a description of the survey results by tree species.

WHITE FIR

Laminated Root Rot

White fir presently dominates the stand in all diameter classes (Tables 1 and 2). Over 5 percent of the white fir/acre have been killed by *P. weirii* throughout all size classes. Over 11 percent of the trees/acre 5.0 or more inches DBH representing 9.4 percent of the basal area have been killed by *P. weirii*. These mortality data represent about half of the trees that are actually infected on the site within the infected portion of the stand. Most of the living grand fir within the infected area shown in Figure 2 probably are infected by *P. weirii*, especially those near pockets of mortality. Current yields of white fir within infected portions of the stand are estimated at 25 percent of normal as a result of tree mortality and growth loss in living but infected trees.

Laminated root rot is one of the most destructive diseases in the Pacific Northwest. It is particularly serious because it does not disappear with stand harvesting and will cause as much damage, if not more so, in future stands of susceptible species. The fungus, *P. weirii*, spreads from roots of infected trees and stumps to healthy roots of adjacent trees or regeneration by root contact. Death from infection may occur in a year for saplings or several years for sawtimber. Infected white fir are often attacked by fir engravers (*Scolytus ventralis*) as was observed in this stand.

White fir[1/] is listed as highly susceptible to laminated root rot (Hadfield and Johnson 1977). Trees in stands dominated by white fir will readily become infected and mortality centers of increasing diameter will develop with time. Overstocked stands where root contacts and grafting are common are particularly conducive to disease spread and mortality center development.

Annosus Root and Butt Rot

Annosus root and butt rot, caused by *Fomes annosus*, was found in large-diameter white firs scattered throughout the stand (Figure 2). About 1 percent of the white fir 5.0 or more inches DBH representing 2.9 percent of the basal area were infected and killed by *F. annosus*. Dead trees often occurred in small pockets of two or three trees. No mortality caused by *F. annosus* was observed in white fir less than 11 inches DBH.

F. annosus infects white fir either through trunk wounds by windborne spores, or by mycelial spread across root contacts. Damage is usually in the form of butt or trunk rot. Tree mortality may occur when trees break as a result of severe decay. Occasionally, mortality occurs as a consequence of fungal infection, causing predisposition to fir engraver attack. In the Ochillee Stand, mortality mainly occurred in large trees that broke as a consequence of severe butt or trunk rot caused by *F. annosus*.

1/ An *Abies grandis* - *Abies concolor* species complex occurs throughout the Ochoco NF. In this evaluation, the complex will be referred to as white fir.

Indian Paint Fungus

Conks of the Indian paint fungus, *Echinodontium tinctorium*, occasionally were observed in large-diameter white firs throughout the stand (Tables 1 and 2). Some trees with conks died when stems broke at points of severe decay. A preliminary survey indicated that 37 percent of the potential white fir crop trees (< 20 inches DBH) had *E. tinctorium* infections. About 1.8 percent of the cubic volume (4.9 percent BF volume) in these potential crop trees is presently decayed by *E. tinctorium* and other decay fungi, including *F. annosus*.

Infection and subsequent decay by the Indian paint fungus of white fir is high in mixed-conifer stands with: (1) poor live crown ratios (<75 percent with fir overstory); (2) previous white fir overstory; (3) northerly aspects; and (4) severe wounding. All these conditions are present in the Ochillee Stand. Decay will increase with time, especially in stands over 125 years.

Miscellaneous Mortality

Mortality due to a variety of causes accounted for loss of half of the total white fir stems per acre but represented only 3.4 percent of the basal area. Most of this occurred in seedlings and saplings in overstocked areas and was probably a result of severe suppression since no pests were found.

Miscellaneous mortality in the larger-diameter classes was caused by a variety of pests, including stem breakage due to severe decay caused by the Indian paint fungus. Some mortality was caused by *Armillaria mellea* and/or fir engravers. These pests frequently attack trees of reduced vigor. Occasionally, *A. mellea* will cause widespread mortality in apparently healthy stands of white fir, but this was not observed in the Ochillee Stand.

Western Spruce Budworm

Evidence of heavy current defoliation caused by the western spruce budworm (*Choristoneura occidentalis*) was observed in nearly all trees listed as "healthy" within the stand. An epidemic of spruce budworm has been occurring in eastern Oregon for about 3 or 4 years, but the Ochillee Stand appears to have been affected only this year. If the budworm population is not treated, defoliation will probably continue for another 6 or 7 years, resulting in severe tree growth loss and some mortality, especially in conjuction with other "opportunist type" pests such as *A. mellea* or fir engravers. The extent of the defoliation in the Ochillee Stand may have masked some symptoms of *P. weirii* infection.

Fir Broom Rust

Fir broom rust, caused by the fungus *Melampsorella caryophyllacearum*, was observed throughout the Ochillee Stand. It causes witches'-brooms that resemble those caused by dwarf mistletoe. Fir broom rust causes affected needles to be yellow and shorter and thicker than healthy needles. Needles fall off the affected broom twigs in the winter, causing them to appear dead. Witches'-brooms caused by fir broom rust do not contain dwarf mistletoe plants.

Severe infection may result in stem malformation, growth loss, and occasional mortality in true firs. Severely infected trees could be removed during thinning operations.

DOUGLAS-FIR

Dwarf mistletoe

Douglas-fir occurs in the stand as scattered old-growth residuals, some second-growth (11-21 inches DBH), and some seedlings and saplings. All Douglas-firs over 5 inches DBH are either dead or infected by dwarf mistletoe (*Arceuthobium douglasii*). Nearly one-third of the Douglas-firs over 5.0 inches DBH, representing 35.2 percent of the basal area, are alive but infected with dwarf mistletoe. Average dwarf mistletoe rating for live Douglas-fir is 4.5. Sixteen percent of the trees were killed by dwarf mistletoe.

Dwarf mistletoe is currently the most widespread and destructive disease affecting East Side Douglas-fir. Dwarf mistletoe infection causes severe reduction in growth, as much as 60 percent, often leading to top-kill and tree mortality (Pierce 1960). This occurs because the parasite is systemic throughout host branches and creates malformations known as witches'-brooms which sap water and nutrients from uninfected portions of the tree. Current Douglas-fir yields in the Ochillee Stand are probably 40 to 50 percent of normal due to severe growth reductions and mortality due to dwarf mistletoe. Healthy appearing seedlings and saplings over 3 feet tall or 10 years old beneath infected overstory trees are probably infected, but mistletoe plants have not become visible due to reduced light.

Laminated Root Rot

Nearly one-quarter of the Douglas-firs/acre over 5.0 inches DBH, representing 21.6 percent of the basal area, have been killed by *P. weirii*. Adjacent, healthy-appearing trees have a high probability of being infected also. As with white fir, current yields of Douglas-fir within infected portions of the stand are probably 25 percent of normal. This is in addition to losses resulting from dwarf mistletoe. Douglas-fir is classified as highly susceptible to laminated root rot.

Miscellaneous Mortality

Twenty-eight percent of the Douglas-firs/acre 5.0 or more inches DBH, representing 21.6 percent of the basal area, have been killed by a variety of pests. Only large-diameter trees were affected. *Armillaria mellea* was found in a few trees. Others were probably killed by either dwarf mistletoe or laminated root rot, but trees were too deteriorated to positively identify the pests.

Western Spruce Budworm

As in white fir, all Douglas-fir tallied as healthy had heavy current defoliation caused by budworm. Prognosis for defoliated Douglas-fir is the same as for white fir.

WESTERN LARCH

Dwarf Mistletoe

Western larch (*Larix occidentalis*) comprises a portion of the overstory, with no stems less than 5.0 inches DBH (Table 1). All of the larch are either infested with dwarf mistletoe (*A. laricis*) or dead. One-quarter of the larch/acre, representing 36.5 percent of the basal area/acre, have been killed by dwarf mistletoe. Living trees have an average dwarf mistletoe rating of 3.4 on a scale of 0 to 6.

Dwarf mistletoe is currently the most damaging pest affecting larch in Oregon and Washington. About 50 percent of the larch type in the Pacific Northwest is infected with dwarf mistletoe. As in Douglas-fir, dwarf mistletoe infection causes severe reduction in growth, as much as 60 percent, often leading to tree mortality (Pierce 1960). Mistletoe-infected branches break off and adventitious branches develop at the breaks, resulting in an all-too-common "telephone-pole" appearance. Such trees die rapidly. Larch yields are probably 20-30 percent of normal in the Ochillee Stand due to severe growth reductions and tree mortality.

Miscellaneous Mortality

Some mortality was observed in larch that could not be successfully diagnosed due to the advanced stage of deterioration. No laminated root rot was found in larch, although the species is listed as intermediately susceptible. If planted in disease centers, some larch will sustain loss, mainly as buttrot, but mortality will be much less than in fir.

PONDEROSA PINE

Miscellaneous Mortality

Ponderosa pine (*Pinus ponderosa*) occurs in the stand, primarily as part of the overstory, but some saplings do occur. About a quarter of the pine/acre, representing 42.5 percent of the basal area/acre, have been killed by a variety of causes. Some trees have been killed by bark beetles; western pine beetle (*Dendroctonus brevicomis*) and mountain pine beetle (*D. ponderosae*). These insects generally attack trees under stress due to overstocking, drought, or other pests such as root diseases. Armillaria root rot was found in dead trees with bark beetle activity.

No laminated root rot was found in pine. Ponderosa pine is classified as resistant to laminated root rot. If planted in disease centers, minor infection may occur, but tree mortality will be rare. No dwarf mistletoe (*A. campylopodum*) was observed in ponderosa pine.

Management Alternatives

The following management alternatives for pest reduction are presented for the Ochillee Stand in increasing order of cost and effectiveness of reducing damage:

1. Do Nothing - Damage as growth loss due to dwarf mistletoes in Douglas-fir and larch; heartrot caused by Indian paint fungus and *Fomes annosus* in white fir; and mortality caused primarily by *Phellinus weirii*, will continue to increase in the present stand. Fir regeneration that becomes established will become infected by dwarf mistletoe and *Phellinus weirii*. As regeneration matures and stagnates, infection and subsequent damage caused by *E. tinctorium* and *F. annosus* will occur. Defoliation by western spruce budworm will continue for several years. The do-nothing alternative would create a pest-infested silvicultural slum.

2. Sanitation/Salvage - A sanitation/salvage program could capture salvageable volume in dead and dying trees before large volumes are lost to decay. However, damage from all pests will continue to increase in residuals.

3. Shelterwood Cut - Because of the dominance of white fir in all diameter classes, a shelterwood cut would result in an almost pure stand of white fir becoming established. In areas infected with *P. weirii*, damage to white fir regeneration will be at least as great, if not more so, than in the present stand. Infected areas will increase in size as the fungus spreads to healthy portions of the stand.

4. Larch/Pine Seed Tree Cut - If all Douglas-fir and white fir are removed from the stand and all unmerchantable trees destroyed, the remaining larch and pine could be used as seed trees to regenerate the next stand. Some encroachment by fir will occur, especially at unit margins. Douglas-fir and white fir should be discriminated against when precommercial thinning. Dwarf mistletoe-infected larch seed trees should be removed before larch regeneration reaches 3 feet tall or at 10 years, whichever occurs first, to prevent reinfection. Future defoliation by western spruce budworm will not occur.

5. Clearcut - Total removal of all merchantable trees and destruction of all unmerchantable trees will eliminate all pests but root disease from the site. If larch, or especially pine, is planted, damage due to laminated root rot will be reduced to an insignificant level. Once pine becomes established, future stocking level control will reduce damage caused by bark beetles. If larch is planted, care should be taken to avoid planting within 100 feet of dwarf mistletoe-infected larch on the margins of the unit. Fir that becomes established naturally within the unit should be discriminated against when precommercial thinning is done. Future defoliation caused by western spruce budworm will not occur.

6. Stump Treatment - Stump treatment by either total excavation of infected stumps or fumigation with volatile chemicals will eliminate most of the fungal inoculum that would serve to infect the future stand. Any species can then be planted on the site. Stump removal is restricted by terrain and would not be feasible in the Ochillee Stand. Stump fumigation is still experimental, very expensive, and probably would not be necessary since pine is a preferred species for regeneration.

Recommended Alternatives

The stand should be delineated into portions that are infected and not infected by *P. weirii* (Figure 2). Alternatives 4 or 5 should be applied to the infected portion of the stand. In the uninfected portions of the stand, Alternatives 3, 4, or 5 can be applied when losses due to stem decay and mortality become unacceptable. This can be determined by running the Fir Decay Program (Filip and Others 1983) on the uninfected portion of the stand.

The information and recommendations presented in this report have been specifically formulated for the Ochillee Stand. Although some of this information may be applied to other areas in Oregon and Washington experiencing similar pest problems, these areas may be sufficiently different from the area we surveyed to warrant a separate biological evaluation to formulate management alternatives specific to that area. Forest Pest Management pathologists and entomologists encourage and are available to perform such evaluations at the request of land managers.

Literature Cited

Filip, G. M., P. E. Aho, and M. R. Wiitala.
1983. Indian paint fungus: a method for recognizing and reducing hazard in advanced grand and white fir regeneration in eastern Oregon and Washington. Forest Pest Management, Pacific Northwest Region, USDA Forest Service, Portland, OR. 18 p.

Hadfield, J. S. and D. W. Johnson.
1977. Laminated root rot: a guide for reducing and preventing losses in Oregon and Washington Forests. Forest Pest Management, Pacific Northwest Region, USDA Forest Service, Portland, OR. 16 p.

Pierce, W. R.
1960. Dwarf mistletoe and its effect upon larch and Douglas-fir of western Montana. Bulletin No. 10, School of Forestry, Montana State University, Missoula, MT. 38 p.

Prepared by:

GREGORY M. FILIP, Plant Pathologist — 11/29/83 Date

Reviewed by:

JAMES S. HADFIELD, Supervisory Plant Pathologist — 11/29/83 Date

Approved by:

PAUL E. BUFFAM, Director, FPM — 12/01/83 Date

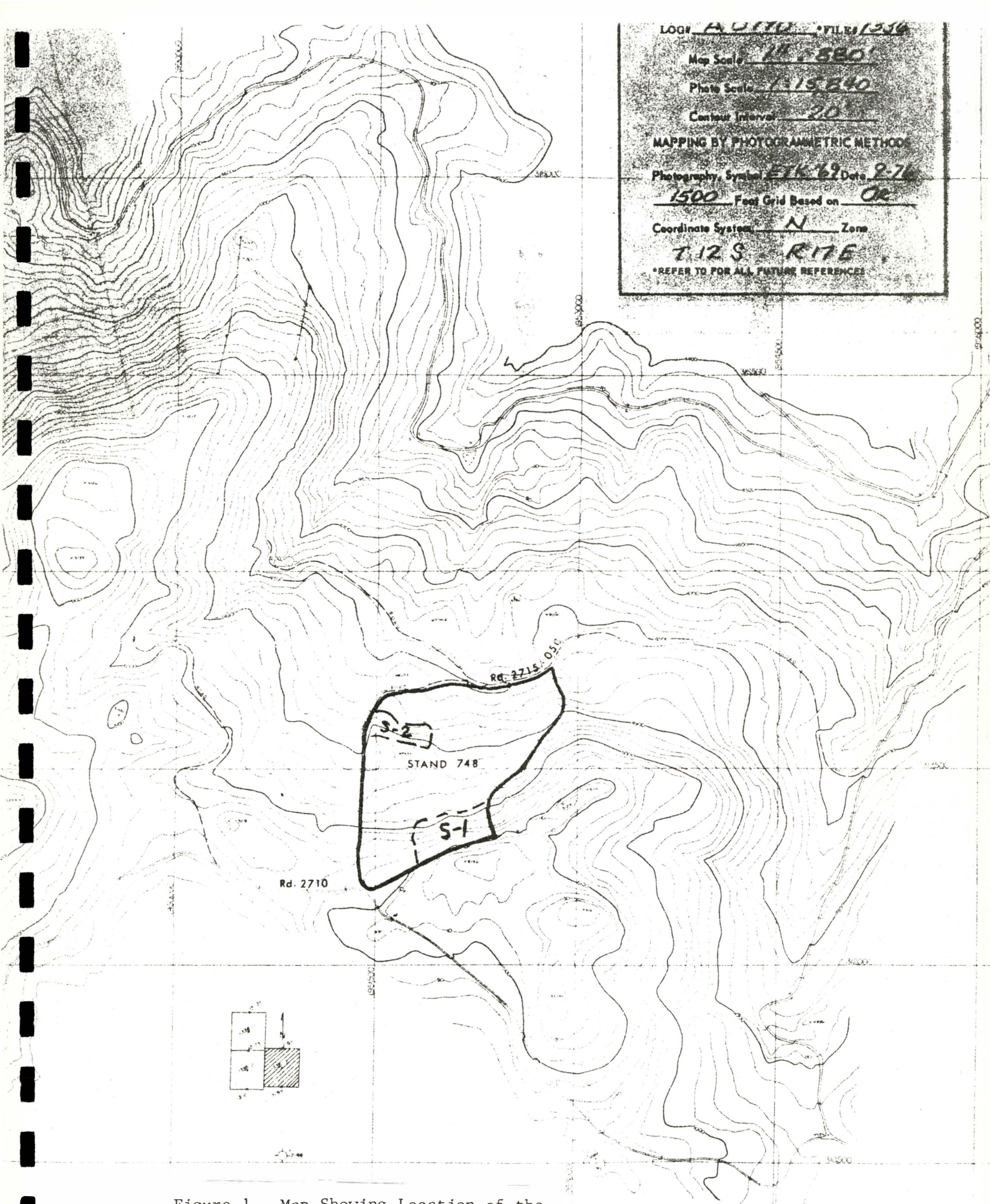


Figure 1.--Map Showing Location of the Ochillee Stand, Ochoco NF

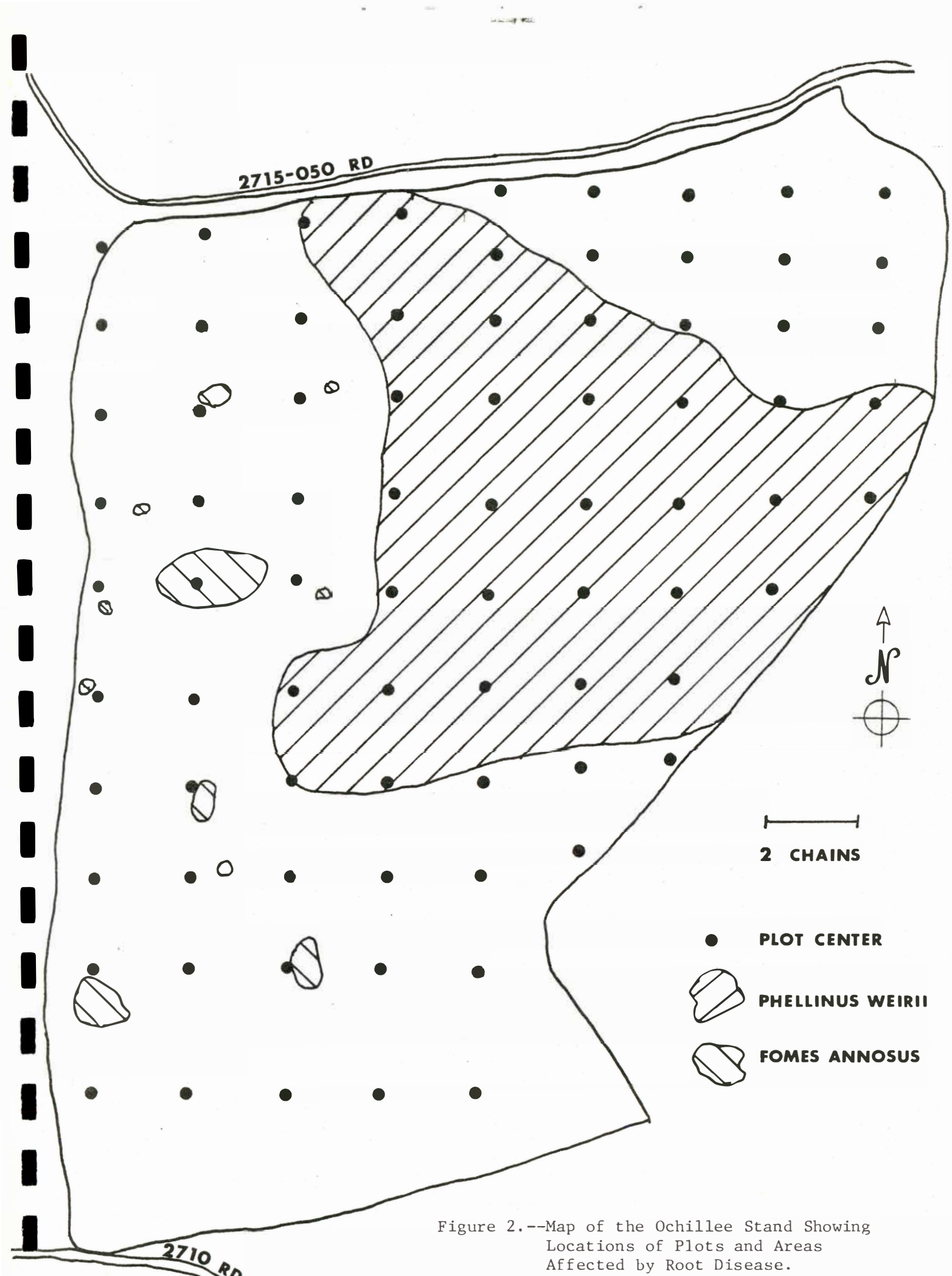


Figure 2.--Map of the Ochillee Stand Showing Locations of Plots and Areas Affected by Root Disease.

Table 1.--Incidence (Trees Per Acre) of Major Diseases and Insect Damage by DBH Class in the Ochillee Stand, Ochoco NF

DBH Class	DOUGLAS-FIR					WHITE/GRAND FIR					PONDEROSA PINE		WESTERN LARCH	
		Dwarf Mistletoe		Phellinus	Misc.		ET	Fomes	Phellinus	Misc.		Misc.	Dwarf Mistletoe	
	Healthy	Live	Dead	Dead	Dead	Healthy	Live	Dead	Dead	Dead	Healthy	Dead	Live	Dead
(In.)	Trees Per Acre													
0.0-0.9	26.7					180.0			2.6	9.1				
1.0-1.9	6.7					46.7				19.5		1.3		
2.0-2.9	6.7	1.3				73.3			1.3	13.0				
3.0-3.9						80.0			6.5	2.6	6.7			
4.0-4.9	6.7					33.3			5.2					
5.0-6.9						40.8			10.6	4.0		1.3	2.7	
7.0-8.9						30.6			1.5	0.7			2.2	1.4
9.0-10.9						17.1			1.0				1.0	1.0
11.0-20.9		0.6	0.3	0.5	0.7	32.0	0.2	1.8	2.8	1.0	1.9	0.3	1.9	1.2
21+		0.2	0.1	0.1		1.8	0.1	0.1	0.5	0.2	0.4	0.1	0.1	
Total	46.8	2.1	0.4	0.6	0.7	535.6	0.3	1.9	32.0	50.1	9.0	3.0	7.9	3.6
Percent	92.5	4.1	0.8	1.2	1.4	86.4	<0.1	0.3	5.2	8.1	75.0	25.0	68.7	31.3
Percent (>4.9)	0	32.0	16.0	24.0	28.0	83.4	0.2	1.2	11.2	4.0	57.5	42.5	68.7	31.3

Table 2.--Incidence (Basal Area Per Acre) of Major Diseases and Insect Damage in the Ochillee Stand, Ochoco NF

DBH Class	DOUGLAS-FIR					WHITE/GRAND FIR					PONDEROSA PINE		WESTERN LARCH	
		Dwarf Mistletoe		Phellinus	Misc.		ET	Fomes	Phellinus	Misc.		Misc.	Dwarf Mistletoe	
	Healthy	Live	Dead	Dead	Dead	Healthy	Live	Dead	Dead	Dead	Healthy	Dead	Live	Dead
(In.)	Basal Area ($Ft.^2$) Per Acre													
5.0-6.9						8.0			2.1	0.8		0.3	0.5	
7.0-8.9						10.6			0.5	0.3			0.8	0.4
9.0-10.9						9.3			0.5				0.5	0.5
11.0-20.9		0.8	0.3	0.5	0.8	33.3	0.3	2.1	2.6	1.3	2.7	0.5	1.8	1.6
21+		0.5	0.5	0.3		6.7	0.8	0.3	2.1	1.0	5.3	0.2	0.2	
Total		1.3	0.8	0.8	0.8	67.9	1.1	2.4	7.8	3.4	8.0	1.0	3.8	2.5
Percent		35.2	21.6	21.6	21.6	82.3	1.3	2.9	9.4	4.1	88.9	11.1	60.3	39.7